

CLAIMS

1 1. A video system comprising:

2 a video processing circuit that receives a picture and provides video compression
3 by using an optimal macroblock mode of operation, the optimal macroblock mode of
4 operation being identified by processing at least one macroblock of the picture, the
5 processing being performed independent of other macroblocks contained in the picture.

1 2. The video system of claim 1, wherein the video processing circuit includes an
2 encoder, the encoder comprising:

3 a motion estimation circuit that identifies an optimal motion vector by processing
4 at least one macroblock contained in the picture, wherein the processing is carried out
5 independent of other macroblocks contained in the picture; and
6 a mode selection circuit that identifies the optimal macroblock mode of operation.

1 3. The video system of claim 2, wherein the mode selection circuit identifies the
2 optimal macroblock mode of operation by using a rate-distortion model, where the rate-
3 distortion model comprises an overall macroblock mode distortion D that is defined by a
4 model equation $D = D^{AC} + D^{DC}$, wherein D^{AC} is a distortion due to AC coefficients and
5 D^{DC} is a distortion due to DC coefficients.

1 4. The video system of claim 3, where D^{AC} is a model equation that is defined by
 2 $D^{AC} = k_1 f(\sigma) g(R_{AC})$, wherein $f(\sigma)$ and $g(R_{AC})$ are two functions, σ is a measure of
 3 deviation of AC coefficients, R_{AC} is an allocated rate for encoding AC coefficients, and
 4 k_1 is a first numerical parameter that comprises at least one of a fixed number, an
 5 estimated number, and a number that is dynamically determined during a frame of the
 6 picture.

1 5. The video system of claim 4, when $f(\sigma) = \sigma^{k_2}$, wherein k_2 is a second numerical
 2 parameter that comprises at least one of a fixed number, an estimated number, and a
 3 number that is dynamically determined during a frame of the picture.

1 6. The video system of claim 4, when $g(R_{AC}) = e^{-k_3 R_{AC}}$, where k_3 is a third numerical
 2 parameter that comprises at least one of a fixed number, an estimated number, and a
 3 number that is dynamically determined during a frame of the picture.

1 7. The video system of claim 4, when R_{AC} is defined as
 2 $R_{AC} = R_{total} - R_{hdr} - R_{mv} - R_{DC}$, wherein R_{total} is a target total number of bits for the at least
 3 one macroblock, R_{hdr} is a rate of encoding a header of the at least one macroblock, R_{mv} is
 4 a rate of motion vectors, and R_{DC} is a rate of the DC coefficients.

1 8. The video system of claim 3, wherein D^{DC} is calculated using a mean intensity
 2 value over the at least one macroblock, and a quantization is carried out using a fixed step
 3 size.

1 9. The video system of claim 3, wherein D^{DC} is equal to zero.

1 10. The video system of claim 3, wherein the optimal macroblock mode of operation
2 is selected as one that minimizes the overall macroblock mode distortion D.

1 11. The video system of claim 1, wherein the signal received from the video signal
2 source is at least one of a JPEG signal, an MPEG-x signal, and an ITU-specified H.26x
3 signal.

1 12. A method for video compression, the method comprising:
2 processing a picture by identifying an optimal macroblock mode of operation; and
3 processing a macroblock of the picture independent of other macroblocks
4 contained in the picture.

1 13. The method of claim 12, wherein identifying the optimal macroblock mode of
2 operation comprises:
3 providing a rate-distortion model;
4 computing a set of rate-distortion values using a set of macroblock modes of
5 operation upon the rate-distortion model;
6 selecting from the set of rate-distortion values an optimal rate-distortion value;
7 and

8 designating a macroblock mode of operation corresponding to the optimal rate-
9 distortion value as the optimal macroblock mode of operation.

1 14. The method of claim 13, further comprising identifying an optimal motion vector
2 by processing one macroblock independent of other macroblocks contained in the picture.

1 15. The method of claim 14, wherein identifying the optimal motion vector
2 comprises:

3 providing a first Lagrangian cost function equation that corresponds to the
4 macroblock;

5 incorporating a first Lagrangian multiplier into the first Lagrangian cost function
6 equation;

7 producing a set of Lagrangian cost functions by applying a set of motion vector
8 values to the first Lagrangian cost function equation that incorporates the first Lagrangian
9 multiplier;

10 selecting a first optimal Lagrangian cost function from the set of Lagrangian cost
11 functions;

12 selecting from the set of motion vector values a motion vector value that is
13 associated with the first optimal Lagrangian cost function; and
14 designating the selected motion vector value as the optimal motion vector value.

1 16. The method of claim 15, further comprising:
2 incorporating a set of Lagrangian multipliers into the first Lagrangian cost
3 function equation to generate a set of Lagrangian cost function equations;
4 identifying a set of motion vector values associated with a set of optimal
5 Lagrangian cost functions that are derived from the set of Lagrangian cost function
6 equations; and
7 designating the set of motion vector values as the optimal set of motion vector
8 values.

1 17. The method of claim 16, wherein identifying the optimal macroblock mode of
2 operation comprises:
3 providing a rate-distortion model;
4 computing a set of rate-distortion values using a set of macroblock modes of
5 operation and the optimal set of motion vector values upon the rate-distortion model;
6 selecting from the set of rate-distortion values an optimal rate-distortion value;
7 and
8 designating the macroblock mode of operation corresponding to the optimal rate-
9 distortion value as the optimal macroblock mode of operation.

1 18. A video processing program stored on a computer-readable medium, the video
2 processing program comprising:

3 logic configured to provide a picture to the video processing program;

4 logic configured to provide a rate-distortion model; and

5 logic configured to identify an optimal macroblock mode of operation by

6 processing a macroblock independent of other macroblocks contained in the picture.

1 19. The video processing program of claim 18, further comprising:

2 logic configured to compute a set of rate-distortion values using a set of

3 macroblock modes of operation upon the rate-distortion model;

4 logic configured to select from the set of rate-distortion values an optimal rate-

5 distortion value; and

6 logic configured to designate a macroblock mode of operation corresponding to

7 the optimal rate-distortion value as the optimal macroblock mode of operation.

1 20. The video processing program of claim 18, further comprising logic configured to

2 identify an optimal motion vector by processing one macroblock independent of other

3 macroblocks contained in the picture.

1 21. The video processing program of claim 20 wherein the logic configured to
2 identify an optimal motion vector comprises:
3 logic configured to provide a first Lagrangian cost function equation that
4 corresponds to the macroblock;
5 logic configured to incorporate a first Lagrangian multiplier into the first
6 Lagrangian cost function equation;
7 logic configured to produce a set of Lagrangian cost functions by applying a set of
8 motion vector values to the first Lagrangian cost function equation that incorporates the
9 first Lagrangian multiplier;
10 logic configured to select a first optimal Lagrangian cost function from the set of
11 Lagrangian cost functions;
12 logic configured to select from the set of motion vector values a motion vector
13 value that is associated with the first optimal Lagrangian cost function; and
14 logic configured to designate the selected motion vector value as the optimal
15 motion vector value.

- 1 22. The video processing program of claim 21, further comprising:
 - 2 logic configured to incorporate a set of Lagrangian multipliers into the first
 - 3 Lagrangian cost function equation to generate a set of Lagrangian cost function
 - 4 equations;
 - 5 logic configured to identify a set of motion vector values associated with a set of
 - 6 optimal Lagrangian cost functions that are derived from the set of Lagrangian cost
 - 7 function equations; and
 - 8 logic configured to designate the set of motion vector values as the optimal set of
 - 9 motion vector values.
- 1 23. The video processing program of claim 22, wherein the logic configured to
- 2 identify an optimal macroblock mode of operation comprises:
 - 3 logic configured to compute a set of rate-distortion values using a set of
 - 4 macroblock modes of operation and the optimal set of motion vector values, upon the
 - 5 rate-distortion model;
 - 6 logic configured to select from the set of rate-distortion values an optimal rate-
 - 7 distortion value; and
 - 8 logic configured to designate the macroblock mode of operation corresponding to
 - 9 the optimal rate-distortion value as the optimal macroblock mode of operation.